"JOURNAL OF THE CONSTRUCTORS CLUB"

Hot Iron

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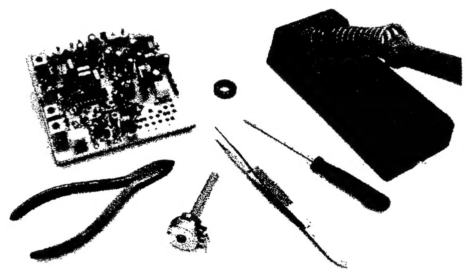
Contents

Editorial



The season for Summer rallies is now upon us and I trust that I will have seen some of your at this year's Yeovil ARC's QRP Convention. I have been etching away these last few weeks, making certain that I have a stock of all kits and trying to guess what will go well! One snag is that there are currently no stocks of PolyVaricon tuning capacitors in this Country! I have asked Maplin to find out if they can air-freight some from their far East supplier - their main shipment being en-route in a shipping container! I had naively thought everything goes by air nowadays!

Some of you may wonder why you don't see me, and maybe other kit suppliers, at rallies around the country - the reason is that it is quite costly in petrol and time attending an event some way off; you need to sell a lot to make it worthwhile. It is very much more effective to run as essentially a mail order business using the web as much as possible. This helps to keep the overheads of running the business down which helps you in the long run!

Kit Developments

It has been an active few months, especially with a most productive visit by Rob Mannion G3XFD, Editor of Practical Wireless. I had already agreed to supply him with one of the latest AMU kits for review by Tex Swann, this will appear in the July issue - it should be out by the time you get this. Rob also had a number of very useful suggestions for projects that we could work on together. The first is a new CW 2 Watt DC TCVR for 80m called the **SIDCOT** which I expect to write up for PW - see later. I have recently made the prototype; it is now working well and about to be tried out kindly by my CW adviser, Eric Godfrey G3GC. It is supplied in the small upright format and the price is £44. I am looking for a few early builders if any of you are interested in a discount! It is more sensitive and stable, with better selectivity than all my earlier designs aimed at that broad specification! It is of intermediate complexity and uses a ceramic resonator VFO.

Rob also suggested a GDO project except that it will actually use FET's - not valves! To avoid the expensive meter, I am contemplating an audio approach with changing pitch for the indication. AC coupling of the squeaker circuit may obviate presets too! More later!

The tri-band CW rig, mentioned last time is progressing slowly but surely! Tim G3PCJ

Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £7 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics– is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ

Rig Updates

Bristol Andy Howgate reports a simple alteration to the wiring of his Bristol which has eased a problem in his rig with the switched capacitor filter (SCF) clock. The problem arises from the filter using a digital clock, actually running at 50 times the desired filter audio cut-off frequency; the radiation from the harmonics inherent in the digital clock signal can sometimes get into the front end. It appears as faint birdies spaced across the band which are extremely sensitive to the rig's tuning owing the high harmonic number. It is present for all settings of the filter bandwidth but the birdies are stronger on the wider phone filter settings because the harmonic number is lower and hence stronger. Altering the fine tuning just a whisker will remove them but it can be annoying! Experience has shown that using screened leads for the two control signals going to the bandwidth selection switch will reduce the radiation - actually that from the unselected wire because the other wire is inactive due to the filtering in the supply line to which it is connected. Andy found that removing the wire completely between point S (for the phone position) and S101 helped greatly. This lets the clock run at a much higher frequency, with far less frequent harmonics, implying a filter bandwidth way above the desired normal audio upper limit of around 2 to 3 KHz. In consequence, the IF filter bandwidth now determines the rig's actual audio bandwidth - the IF filter bandwidth is about 3 KHz so the consequence is that phone audio has a slightly wider bandwidth than when the switched capacitor filter was acting normally for phone. The slope of the IF filter is also shallow than that of the SCF. With the other side of S101 left connected to point Q, as originally intended, the CW facility is unchanged with the preset RT101 still active to reduce the SCF bandwidth as required. The narrower CW bandwidth already means the birdies are hardly noticeable. I have not altered the Manual since it does not affect every rig.

Midney on 20m Several years back, I had a batch of TOKO 3335 coils whose temperature characteristics were worse than normal leading to drift problems with the 8 MHz VFO of the Bruton. The same circuit is used in the Midney and recently one or two 20m rigs have shown the same problem. (This particular TOKO is not used in the VFO on other bands.) I repeat the suggestion in Hot Iron 19 (Spring 1998) which came from Hans Puhringer OE3HPU, of changing the troublesome TOKO coil to a powdered iron toroid. Without any other changes, a 12 turn winding on a red T50-2 toroid, tapped at 3 turns from the ground end for the 2N3819 source connection, worked very well. The inductance can only be varied by adjusting the turn spacing. So as before, set the tuning to highest VFO frequency, adjust the turns to set the upper actual VFO frequency limit, then swing to low frequency end of the tuning controls and adjust the preset to set the lower VFO frequency limit. I anticipate that it will not be long before I have to alter the Midney's tuning to use a PolyVaricon capacitor owing to existing BB212 varactor diodes becoming like 'hens teeth' - to use an agricultural expression! In fact, the comment also applies to most 'high' capacity varactors.

Somerset Contest Winner

As usual the purpose was to encourage the use of home built gear! Peter G3XJS (on behalf of the GQRP Club) again very kindly has done the hard work despite other very pressing matters. The first prize of a £50 voucher for Somerset Range gear was won by Dan Taylor GW0EGH. Well done Dan! Peter comments 'he submitted the log with the highest sore (70), having used a 40m homebrew TCVR based on the Belthorn design ... 2 MHz VFO, 9 MHz IF and Club filter with a cheap dynamic mic. The aerial was a bent dipole at about 23 ft (specifically erected for the Contest), supported on various poles and bamboo canes. In the true spirit of the Contest'

The rules were changed to allow more bands etc. which did gain a couple of overseas entries. But the level of response has been poor for a number of years so we have decided to call it a day - shame - but something different is needed.

So - Ladies and Gentlemen - what sort of event or thing would you like me to sponsor?

The aim should be to encourage the building and use of more homebuilt gear? I don't mind if they are not kits - I just would like more people to enjoy the thrills of using their own creations! All ideas are welcome - please let me have any suggestions! G3PCJ

Driving a monopole antenna

Andy Howgate asked me what I thought about a scheme outlined in PW (April 2002) for feeding RF to a vertical monopole radiator. I was not too impressed so passed it to my antenna advisor G3GC for a proper comment! In essence the scheme uses a matching toroidal transformer at the bottom of a vertical radiator made out of twin feeder as sketched right below. I was told there is/ might be a commercial version of this known as The Penetrator using a metal pole radiating element, hence it came to be known by us three as the P Pole! The more I think about it, the more I am convinced this was an elaborate April Fool article which certainly had me, and I gather quite a few others! I feel it is worth repeating Eric's comments as they are technically worth repeating to remind us of good practice. I have paraphrased them slightly:-

1. I can see no reason for having two in phase secondary windings since the two pieces of aerial wire could be attached to a single winding. As the article infers the two windings have equal in-phase voltages, so they may be joined together or left apart which would not make any difference. A single (heavier gauge) secondary wire with the same number of turns could replace the two separate secondary wires. The far ends of the two aerial wires attached to this single winding could still be joined together or not, with impunity.

2. Regarding the transformer, I view with grave misgivings the suggestion that if a T220/2 toroid is not available then a scanning coil toroid from an old TV may be used. These are for use around 15 KHz and would in no way be satisfactory at HF let alone up to 430 MHz. Whilst I do not know the characteristics of a T220/2 (intended for low/medium HF—G3PCJ), I very much doubt if it would also be satisfactory over this range of frequencies.

3. The article states that "My experience is that the matching on all bands is reasonably flat across the bands, though it may be a little higher than you would expect. (It is however tameable with a tuner)". Unfortunately there are no SWR figures given but if they are high then the change over an amateur band will be small since any difference will be swamped by the high standing SWR.

4. Another reason for the flatness of the SWR could well be losses in the toroid which, as I have said, I do not believe could cover such a large range of frequencies.

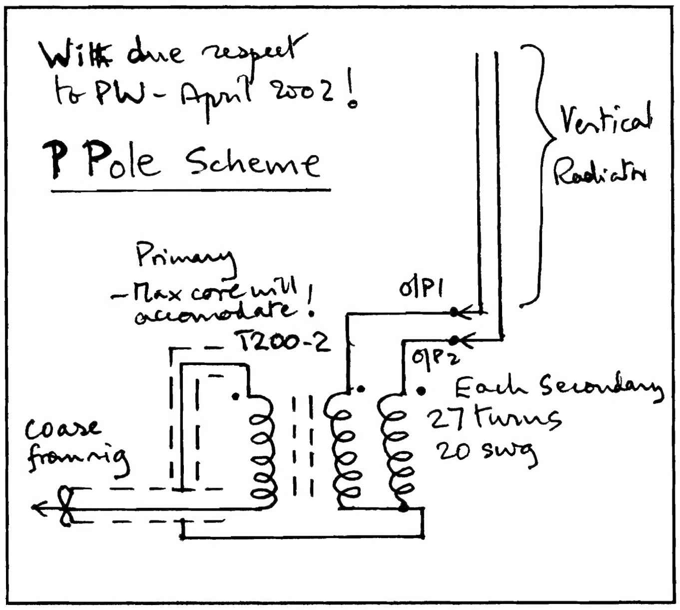
5. The design of the transformer is left wide open. The number of secondary turns is given as twenty seven but the number of primary turns is not given but simply stated to be the maximum possible.

6. A point which in my opinion should not be overlooked is the matter of earthing. As with all end fed aerials satisfactory operation is only likely when a counterpoise is used. The article suggests one is not required but I do not think this is likely to be always assured. In my opinion one should always play safe and have one.

7. A fellow member of YARC, who is an instructor for the new licences, has demonstrated that even a poor antenna will enable reasonable contacts to be made - he worked around the country with a few watts using a wire laid around his landing floor!

Snippet!

A recent note in the IEE's Electronics Systems and Software journal discusses advances in software radios. In such radios, nearly all the filtering and amplification is done in the software, leaving only the RX front end as conventional analogue circuitry. The signals are then converted in an A to D converter for digital processing in the RX's micro- processor. The technique is already widely used in Amateur Black boxes but what amazed me was the comment that 'rapid single flux quantum digital logic will operate to 250 GHz', I repeat 250 GHz! Staggering! Hence practically no need for front end down conversion to reduce the frequency/bandwidth of the signals that have to be digitised.

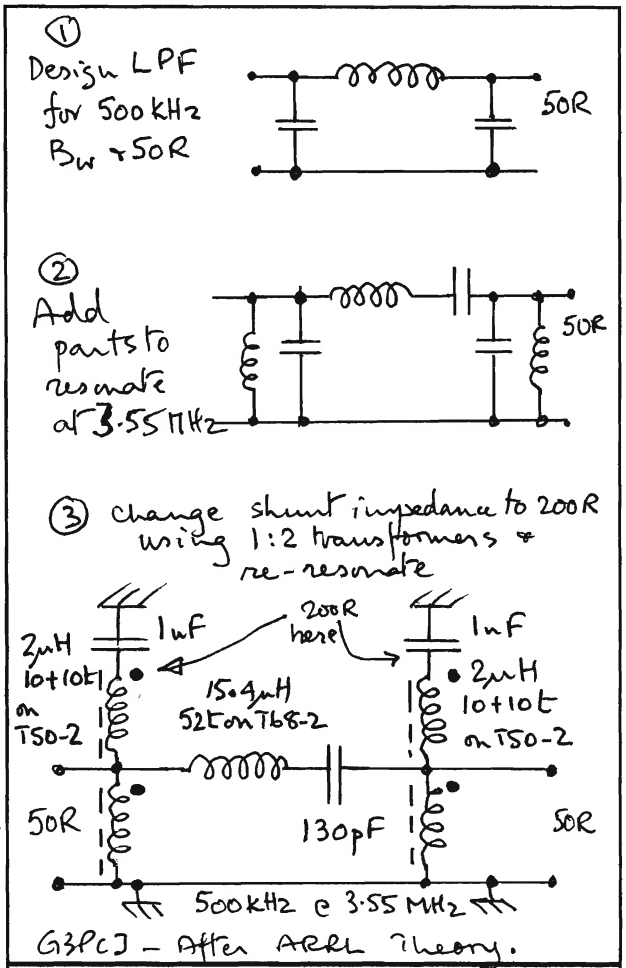


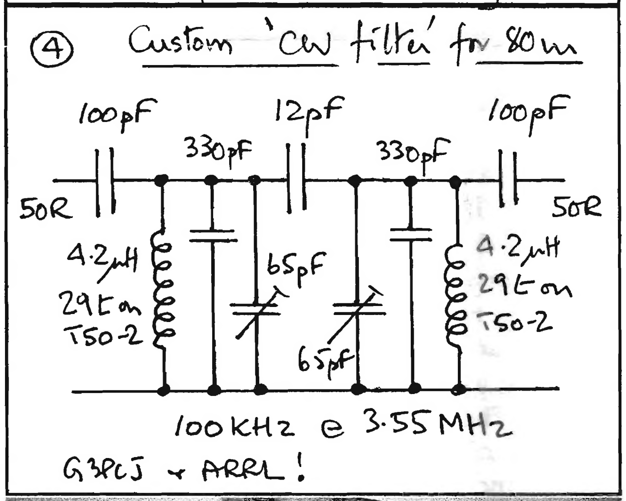
Capacitor types and RF filters

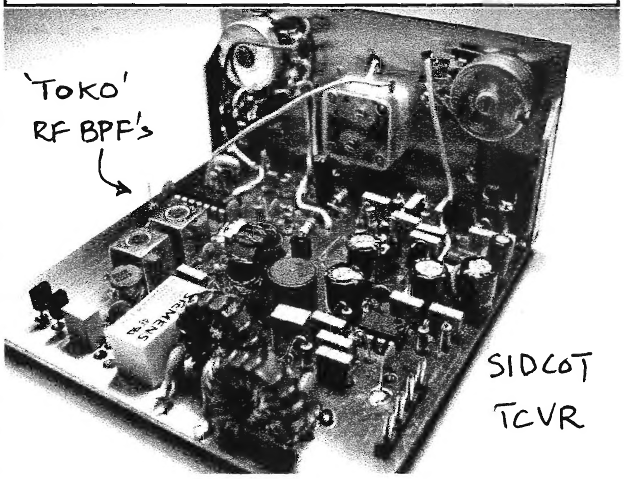
During recent development work on the new direct conversion CW rigs, I wanted to incorporate good RF filters to reduce the chances of broadcast station interference. However, as ever, space was in very short supply and a complex filter would also add appreciably to cost for three bands. I investigated several possible configurations, ideally without any trimming capacitors. One approach for a 'custom' bandpass filter is to design it first as a low-pass filter having a cut off frequency equal numerically to the desired bandwidth of the bandpass filter; this low pass filter is then changed to a bandpass design by adding series capacitors to resonate the low pass series inductive elements, and inductors in parallel to resonate the shunt low pass capacitors. These extra parts should have values to resonate at the centre of the bandpass filter. This can lead to impractical (large or small) values in a 50R system so an impedance transforming inductor can be used to make values more practical. The scheme right (500 KHz bandwidth at 3.55 MHz) above looked possible but the RF voltages would be high as it would be connected during transmission. I hoped to use the same style of small yellow high voltage (1 KV) disk ceramic capacitors that were intended for the TX output low pass filters. I soon realised that the desired bandwidths (100 KHz at up to 14 MHz) would not permit a solution without any form of trimming!

To keep the values practical, an alternative approach (shown right) seemed more sensible and this can also easily cater for differing input and output impedances. (Neither approach involves easy maths which I will spare you!) After extensive trials taking nearly two weeks on a prototype rig, I eventually came to the conclusion that all versions were acting like attenuators! This was swiftly confirmed by measurements on the filters with a signal generator! It took several more days to realise that there must be something funny about those HV disc capacitors! A quick change to silver mica capacitors (because they happened to be handy) changed the circuit to a filter! CONCLUSION. Those particular HV discs are just too lossy - avoid them in high Q resonant circuits!

It was not long after that I realised the three band rig was just too complex to fit into the small upright design format; two separate designs being better - the simpler single band SIDCOT 80m TCVR is shown right. The SIDCOT has semi break-in TR relay control (thus not inflicting transmit voltages on the RX RF filters) so it uses the easier conventional TOKOs. I am pleased to report the SIDCOT passed the G3GC tests with good reports! (The three band rig will have the custom better filters above with electronic TR and 5 W output so it will need a whole 100 x 160 mm PCB.) G3PCJ.





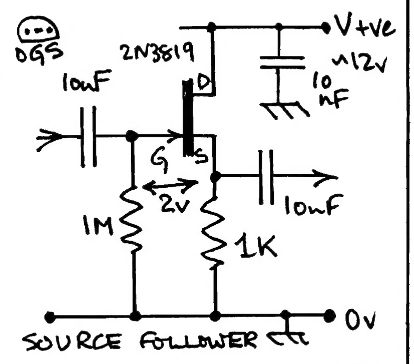


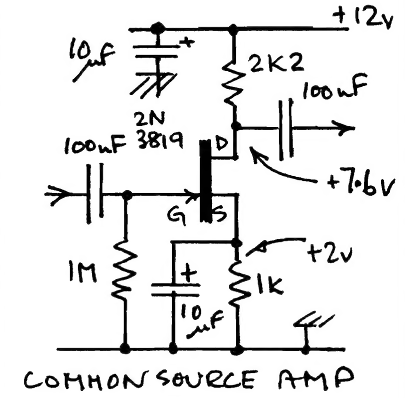
Field Effect Transistor (FET) biasing

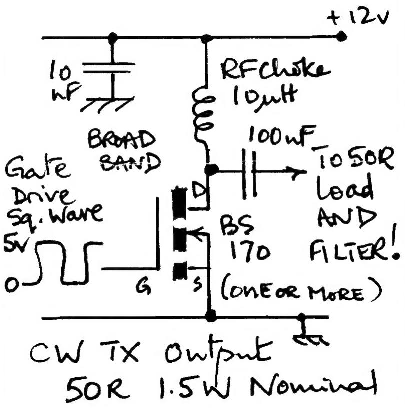
A member has requested something on this vast subject! A simple point to note is that they are all voltage controlled devices unlike bi-polar transistors which have current control. Firstly *junction* FETS; these are usually depletion mode devices where even with zero bias voltage on the gate, there is significant current flowing between drain and source. In the case of the common 2N3819, the zero gate voltage bias current is between 2 and 15 mAmps! In most circuits this is too wide, so a negative bias is often applied to reduce the nominal and range of actual current. Often a resistance is put in the source lead; this makes the gate, if actually at 0 volts, appear negative with respect to the source - as shown right. The upper circuit right shows a source follower where the source is biased about 2 volts above ground so that it can handle signals of up to about + & - 2 volts peak. The reduction in current range also makes it easier to set the drain voltage relative to the source in a voltage amplifying stage - neither too high nor nearly zero when the device is said to be 'bottomed'. The source resistor would be bypassed for signal frequencies. Such devices are used for **linear** applications where the output should always have a constant relationship to the input - i.e. the same gain for all useful signal levels up to some value where the circuit starts to limit - on the supply rail or by bottoming.

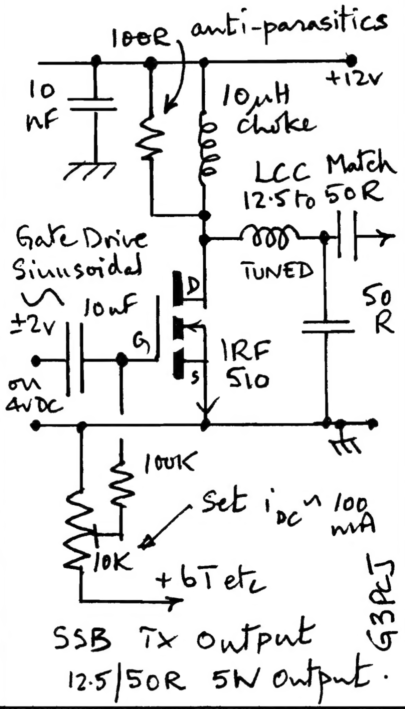
The small metal oxide MOSFETs, like the BS170 that I use a lot, are enhancement mode devices. With zero gate bias, there is no current through it - so for normal linear use they have to have a positive gate bias to turn it on. The gate has to be more than about 2 volts above the source, then current changes rapidly with applied gate voltage. So depending on the drain load, this current may cause the drain voltage to dip close to the source voltage (bottoming) or to some intermediate value for linear operation. If the gate voltage goes on above the voltage at which it bottoms, the device is turned on for the maximum current that the drain load will permit - it is acting like a switch. This is **non-linear** operation and is typical of digital circuits. The gate voltage of these devices can go somewhat higher without damage. When used in the output stage of a CW transmitter, they can be driven like this from a digital logic signal switching between 0 and 5 volts. See middle diagram. The RF load defines the device actual current. Such stages have to be followed by sufficient filtering to remove the unwanted harmonics.

The larger devices like the IRF510 have somewhat higher gate turn on voltages - near 4 volts. They can be used in the non-linear mode (with 5 volt digital drive plus a small positive DC bias voltage) but I mostly use them in **linear** output stages for SSB phone signals. (If you put SSB through an overdriven output stage making it non-linear, the severe distortion of the signal will sound awful! The input and output are no longer directly in proportion to each other.) If any of these enhancement mode devices (large or small) are to be driven **linearly**, the maximum output will occur when the device is just starting to bottom. The peak gate drive signal may not be sufficient to turn the device on this far so it is common to apply a small DC bias which will provide a small drain current even without any modulating signal as shown right. This is Class AB operation. The bias is normally removed during reception. It is part way to Class B operation where two devices can be used in push pull with practically zero standing current when there is no modulating signal. It's a big subject so I hope this raises other questions! G3PCJ





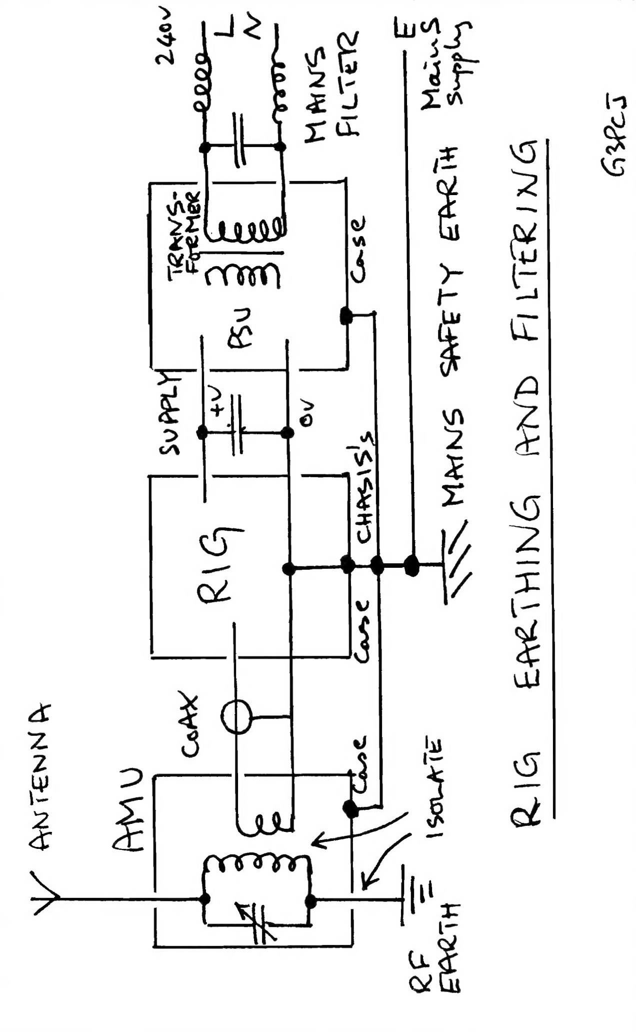




Supply filtering and earthing

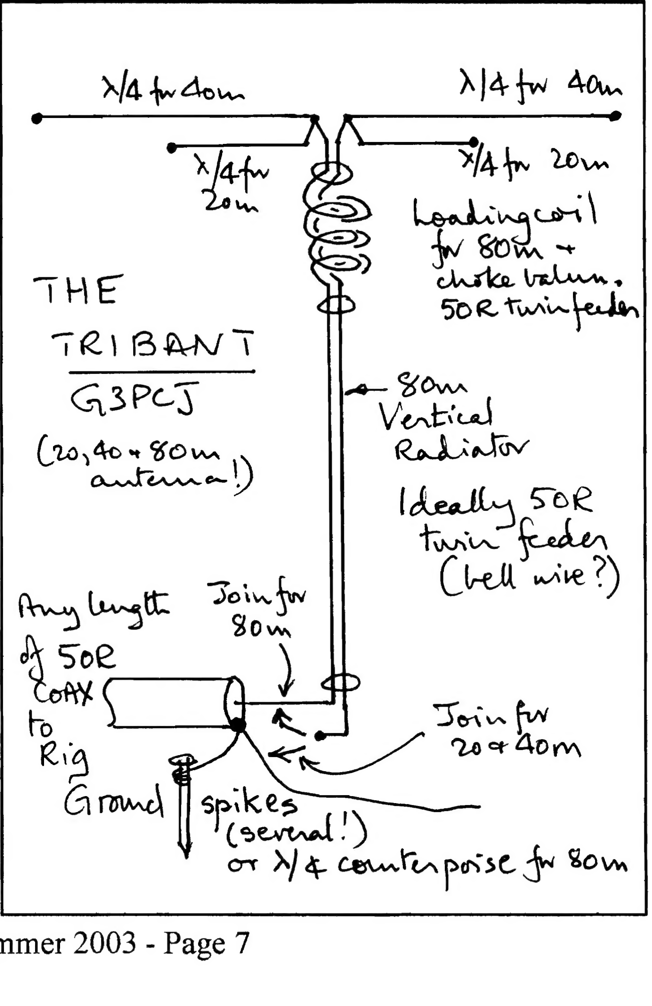
Andy Howgate told me some while back of a peculiar problem that he had which caused his DC supply volts to appear between mains earth and the RF earth! In between finding this out, at least one PSU died and had to have a new set of rectifiers! The same supply also had a blown ceramic capacitor filter on the positive line! I regret I cannot recall the exact mechanism but this supply also had capacitors between both output rails and mains earth which was also connected to the chassis. One of these had gone short circuit and was putting the supply volts where it should not have been!

I have sketched right how the supplies and their filtering ought (I think!) to be connected. Any filter capacitors should be across the supplies and not to mains or RF earth. Mains earth must not be connected to RF earth, especially if your mains earth uses Protective Multiple Earthing (PME). The reason is that PME uses the supply neutral also as earth conductor, hence everything, cases and all, goes live if the neutral breaks. So you should not be able to touch real RF earth and mains earth at the same time lest there is 240v between them! Furthermore, any mains filtering should not have capacitors between either supply line and mains earth as the current through them will cause the earth leakage trip - properly called a residual current device and often set for 30 mA max - to turn everything off! G3PCJ



The Tribant!

No this is not a car! Its intended to be a tri-band antenna for 20, 40 and 80m - perhaps even suitable for /P use! Exact details have yet to be decided but the principle is to have a pair of dipoles for 20 and 40m connected in parallel and fed with twin close spaced low impedance feeder. The reason for the latter is that some of the feeder is wound into a 'choke balun' just below the centre of the dipoles. On 80m this balun acts as a loading coil for the vertical twin feeder section below the balun making use of the two HF dipoles acting as capacity hats above the balun loading coil. The amount of choke balun inductance required to achieve resonance on 80m will depend on the height of the vertical section. The vertical has to be worked against RF spikes/radials or a counterpoise for 80m. On 80m, the feed lines are strapped at the bottom of the vertical section; for the higher bands, the feeders can be connected by coax to an unbalanced rig or AMU output. At the bottom of the vertical section, the impedance on all bands should be low when properly adjusted, hence an AMU should not really be required. Its only an idea - more details later if and when I have tried it out! G3PCJ



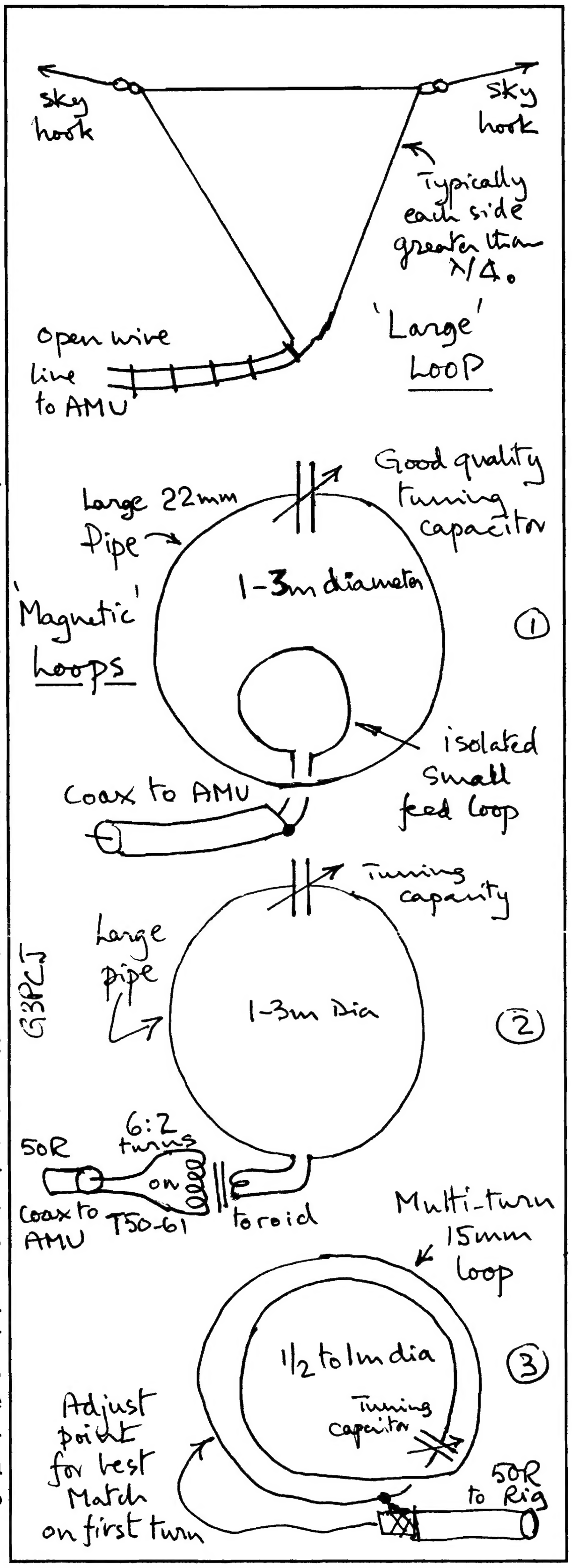
Loop antennas

Both Club members Andy Howgate & David Proctor have raised this broad topic which I hope Eric G3GC will address in due course; in the meantime here are a few thoughts. There are 'conventional' antennas formed into 'loops' where each nominally straight side exceeds roughly one quarter of a wavelength. They can be triangles, circles or squares mounted in the horizontal or vertical plane. Generally they do not have any loading coils or resonating capacitors. Input impedance at any break in the circumference will depend highly on actual length and frequency. Often it is best to feed them with open wire line and a good matching unit. The main advantage is usually some gain over a dipole and sometimes a bit of directivity. See right for an example.

Physically small loops are usually 'magnetic' loops and are brought to resonance with a good quality capacitor - because the high Q leads to very high voltages. Remote tuning is desirable to avoid hand or body effects. The loop circumference is usually well below a quarter of a wavelength. THE advantage is small size, coupled with reduced noise on reception. They can be any shape of single or multiple turns; due to the high circulating currents large diameter copper tubes are best to reduce losses. There is much debate about their transmit efficiency - see June 2003 Technical Topics Radcom! There are three main feed methods, depicted right. Any of these may have a Faraday screen to reduce pick up of unwanted local interference. Firstly with a small electrically separate coupling loop. I have always felt adjustment of this type to be a bit hit and miss!

The main loop can be fed with an input transformer; typically with a couple of turns on the secondary connected in series with the loop and physically half way round opposite the tuning capacity. The primary would have say three times the number of turns on the secondary. For QRP use a ferrite core FT50-6 .

My own preference is for direct feeding by a tap on the first (or only) turn. This is the circular equivalent of the gamma match for a straight antenna. For convenience, the feeder outer is connected to one side of the tuning capacitor but this can upset symmetry; the inner is connected part way round the first turn at a position which gives the best overall match. No AMU is required! Its delightfully simple! G3PCJ



SUBSCRIPTIONS!

I regret its that time again! Due to a rise in postal charges and my endeavours to have eight pages for each issue, I regret I need to raise the fee to £7 per year. (Its been £6 for 10 years!) As before, cheques payable to Walford Electronics please. Do it while you think of it now! Please do take the opportunity to tell me what you would like covered or if you have any questions or ideas for new projects. Even better still, write me an article! Many thanks for your support and encouragement over the last 10 years that I have been doing Hot Iron! Tim Walford G3PCJ.